RELIABLE COMMUNICATION IN VANET USING ENHANCED GRAPH BASED RELIABLE ROUTING PROTOCOL

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Abstract: The cooperative vehicle safety system (CVSs) of Vehicular Ad-hoc Network (VANET) gives indispensable vehicle tracking information. In CVS, the physical state data about the vehicles is transmitted over an imparted wireless channel so as to let the neighbours to track the area of the vehicle. The position of the vehicles is tracked in order to enable communication between the vehicles and predict feasible accident. Subsequently, the need of productive and robust routing protocol emerges to empower more effective communication. Thus, in this paper an Enhanced Graph based Reliable Routing Protocol (EGRRP) is employed in the communication sub component of the CVS framework to transmit the location data of the vehicle quickly. The performance of the proposed methodology is examined in terms of throughput, packet delay and packet delivery ratio. Accordingly, the results demonstrate that the proposed methodology provides an efficient and robust communication over VANET.

Keywords: Cooperative vehicle safety systems, Vehicular Ad-hoc Network, vehicle tracking information, Enhanced Graph based Reliable Routing Protocol.

I. INTRODUCTION

VANET [1,2] is an advancing innovation and a key Intelligent Transportation System (ITS) [2] part that are coordinated with medium and short range remote communication. They support a wide variety of applications such as infotainment, intelligent transportation, passenger convenience, road safety and so on [3]. The essential objective of VANET is conveying comfort and security venture. A vehicular network (VANET) [4] is exceptionally dynamic because of two reasons: rate of the vehicles and attributes of radio propagation. Consequently, VANETs and MANETs [5] introduce some comparative attributes, for example, low data transmission, short scope of transmission and Omni directional telecast. However, VANETs have some unique characteristics such as: high dynamic topology, frequently disconnecting network, geographical type of communication, constrained mobility and prediction. Vehicular networks (VANETs) generally support two main categories of applications: driver assistance and information dissemination. Driver assistance encompasses applications that support drivers in their driving to make it more secure and more efficient. Information dissemination [6] applications focus on providing information to both drivers and passengers, and even vehicles. This information might be adapted to the context of the users. Some possible information types that can be disseminated in a VANET are: info mobility, mobile e-commerce, infotainment, notification services, platooning and vehicle tracking. To track vehicle information, cooperative vehicle safety systems (CVSs) of Vehicular Ad-hoc Network (VANET) can be used. In CVS, the physical state information about the vehicles is transmitted over a shared wireless channel in order to let the neighbors to track the location of the vehicle and predict possible accidents. However, the physical state information’s are beneficial only if they
delivered in a timely manner. Thus, the need of efficient and robust routing protocol arises in order to enable more efficient communication. In this paper, a modified graph-based reliable routing protocol is used for efficient and robust delivery of messages to other vehicles. Using this protocol, the communication subcomponent sends and receives safety messages to and from the vehicles.

II. RELATED WORK

A new congestion control framework has been proposed [7] for uni-priority of event-driven safety messages. Here, priority-based Earliest Deadline First (EDF) scheduling algorithm has been introduced schedule uni-priority of event driven safety messages. Moreover, a novel broadcasting technique has been developed to prevent the broadcast storm. In [8] cluster-based risk-aware CCA (C-RACCA) system has been introduced in which a cooperative collision-avoidance (CCA) approach has been employed to avoid flooding of emergency messages and the target vehicles are organized into clusters. The clustering of the vehicles is done based on the movement and the inter-vehicular distance. To deal with the stable and safe operation of the vehicle intraplatoon information management approaches have been proposed [9]. It has been demonstrated that the utilization of proactive information of both the platoon leader and the follower considerably affects the stability of the platoon string. [10] Employs vehicle trajectories of the traffic simulation in order to analyze the effects of Adaptive Cruise Control (ACC) on the acceleration and deceleration rates of the vehicle. The simulation indicates that the ACC improves the traffic condition in terms of decreased acceleration and deceleration rate however the macroscopic traffic properties remains unaffected. In [11], authors proposed a parking-based data dissemination plan, which tackles the free asset offered by roadside parking for data dissemination in urban territories. The results demonstrate that our plan accomplishes a higher conveyance ratio with lower network load and sensible conveyance delay. Our parking-based data dissemination plan shows a low capital overhead by misusing the free assets offered by stopped vehicles and a low operational overhead through effective operations. [12], propose the thought of Parking Backbone, which does not require any RSUs however powers a virtual overlay network shaped by outside stopped vehicles to convey messages between moving vehicles. We research our plan through reasonable study and reenactment. The results demonstrate that our plan accomplishes elite in message dissemination. In [13], we created a VANET model system for urban situations utilizing IEEE 802.15.4 consistent gadgets. Reenactment based estimations of the assessed signal quality and radio link quality qualities are gotten and contrasted with estimations in outside conditions with approve an executed VANET system. The results affirm the likelihood of actualizing minimal effort vehicular correspondence systems working at moderate vehicular rates. The system conceivably screens the recognizable proof number of the vehicle and also the estimations of the sensors set on it. It yields just exceptionally shorter range. It has lower vitality densities for higher separations from the source.

III. ENHANCED GRAPH BASED ROUTING RELIABLE PROTOCOL (EGRRP)

The Enhanced Graph based Routing Protocol has been proposed to provide reliable communication between vehicles. This approach associates two tuples \{t, Ir_t\} with every edge where t represents the current time and Ir_t indicates the reliability value of the link at the time t. The reliability of the link at the time t can be computed as
\[ l_{r,t}(t) = \begin{cases} \int_t^{t+\alpha} f(t) dt & \alpha > 0 \\ 0 & \text{otherwise} \end{cases} \quad (1) \]

\[ f(t) = \frac{2}{\sigma_{2V} \sqrt{2\pi}} \frac{1}{t^2} \exp\left(-\frac{(2d - \mu_{2V})^2}{2\sigma_{2V}^2}\right), \text{ for } t \geq 0 \quad (2) \]

Here, \( 2d \) represents the maximum distance within which the communication between the vehicles is possible, \( \mu_{2V} \) and \( \sigma_{2V}^2 \) indicates the variance and average value of the relative velocity. In this graphical model, if the communication is not possible between the vehicles then their corresponding reliability value is set to zero. The most reliable route is found based on the most reliable journey which is defined as

\[ R_j(a, b) = \prod_{k=1}^{m} r_t(e_k), e_k \in J(a,b) \quad (3) \]

The proposed approach retains an array known as reliable graph that comprises all the vehicles and their corresponding reliable values. The algorithm starts by initializing the reliability of the source vehicle to zero and all other vehicles to infinity. The pseudo code of graph based approach is given in fig 1.

### A. Route Discovery

When a node (vehicle) requires a connection, it broadcasts a route request (RREQ) message to all its intermediate vehicles. If an intermediate vehicle receives the RREQ and if the vehicle has the route to the destination vehicle it generates an route reply message to the source. Moreover the intermediate node records the information about the node from which it received the RREQ and forwards the message to the other vehicle. Once the RREQ arrives at the destination, the destination generates RREP and transmits it back to the source vehicle. In case of link failure RERR (route error) messages are generated in order to repair the current route or find a fresh route.

### B. Location Detection

In order to identify the location of the vehicle at the time \( t \), mobility model is applied. In this model it is assumed that vehicles travel with a constant velocity \( v_i \) along the direction \( \delta_i \). The location of the vehicle can then be obtained by using the following equations

\[ \Delta x_{i,j} = v_i \cdot \Delta t \cdot \cos \delta_i \quad (4) \]

\[ \Delta y_{i,j} = v_i \cdot \Delta t \cdot \sin \delta_i \quad (5) \]

Here \( \Delta x_{i,j} \) and \( \Delta y_{i,j} \) distance between the vehicles along \( x \) and \( y \) directions, \( \Delta t = t_j - t_i \) respectively.

### IV. PERFORMANCE ANALYSIS

#### A. Simulation Setup

Simulations are carried out to evaluate the performance of the proposed approach. Here, NS2 is used as simulation environment to perform simulation. The performance of the proposed approach is analyzed in terms of throughput, packet delay and packet delivery ratio respectively. Table 1 indicates the
performance metrics and their corresponding formula.

**Table 1: Performance Metrics**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Performance Metric</th>
<th>Formula</th>
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<tbody>
<tr>
<td>1</td>
<td>Throughput</td>
<td>( T = \frac{\text{Number of packet sent}}{\text{time period}} )</td>
</tr>
<tr>
<td>2</td>
<td>Delay</td>
<td>( d = \frac{\text{packet departure time}}{\text{packet arrival time}} )</td>
</tr>
<tr>
<td>3</td>
<td>Packet delivery ratio</td>
<td>( pdr = \frac{\text{number of packets received}}{\text{total packets sent}} )</td>
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**B. Results and Discussion**

The ratio of the quantity of got data packets to the quantity of aggregate data packets sent by the source. Fig 2 shows the packet delivery ratio of proposed technique at varying time units. The horizontal line represents the velocity while the vertical line represents the packet delivery ratio. It is observed from the graph that the packet delivery ratio of the proposed approach is more when compared to the existing technique.

**Fig 2** Packet delivery ratio

Throughput is generally measured in bits per second. Fig 3 shows the number of packets that are transmitted by the proposed technique at varying time units. The horizontal line represents the velocity while the vertical line represents the throughput in kilo bits per second. It is observed from the graph that the number of packets transmitted using the proposed approach is more when compared to the existing technique.

**Fig 3** Throughput

The normal rate of successful message conveyance over a communication.

**Fig 4** Average end-to-end delay
V. CONCLUSION

Cooperative vehicle safety system was developed for vehicles safety purpose. The cooperative vehicle safety systems (CVSs) of Vehicular Ad-hoc Network (VANET) provides vital vehicle tracking information. These are beneficial only if they delivered in a timely manner. Thus, in this paper an Enhanced Graph-based Reliable Routing Protocol (EGRRP) is employed in the communication sub component of the CVS system to generate and transmit the location information of the vehicle rapidly. Simulations are performed to analyze the performance and the experimental results indicate that the proposed approach provides efficient and robust communication between the vehicles.

REFERENCES